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**Kim**

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(54) **BATTERY PACK**

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(\*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 219 days.

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(30) **Foreign Application Priority Data**

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**H01M 2/10** (2006.01)

**H01M 2/02** (2006.01)

**H01M 10/04** (2006.01)

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(52) **U.S. Cl.**

CPC ..... **H01M 2/1077** (2013.01); **H01M 2/0207** (2013.01); **H01M 10/0413** (2013.01); **H01M 10/0445** (2013.01)

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(58) **Field of Classification Search**

CPC ... H01M 2/1077; H01M 2/20; H01M 2/1022; H01M 2/1016

USPC ..... 429/98, 99, 100

See application file for complete search history.

(57) **ABSTRACT**

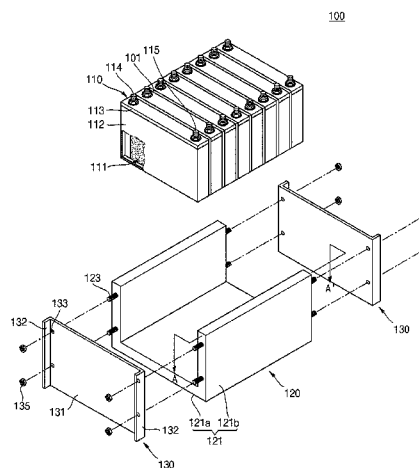
A battery pack including a frame integrated with a reinforcement member and a supporting member, thereby realizing a compact and lightweight dimension. The battery pack includes a plurality of battery cells stacked on top of each other, a frame including a supporting member covering the plurality of battery cells and a reinforcement member formed inside the supporting member, and an end plate disposed at the exterior of the plurality of battery cells and coupled to the frame.

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**18 Claims, 5 Drawing Sheets**



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FIG. 1

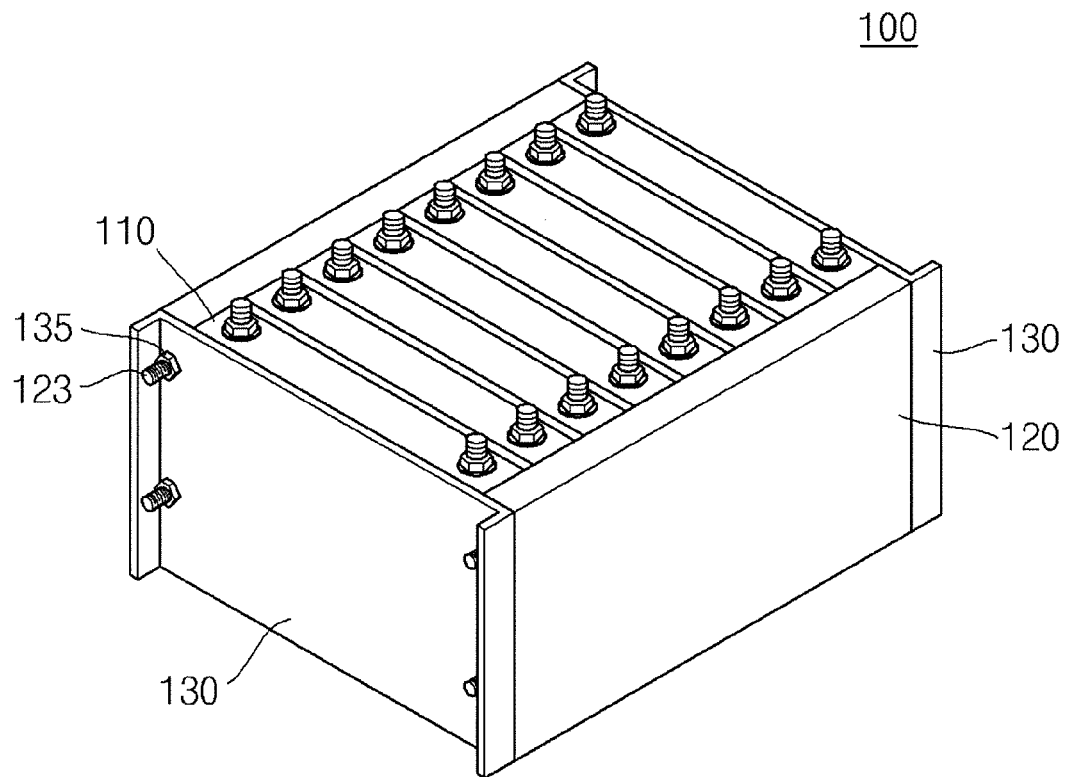


FIG. 2

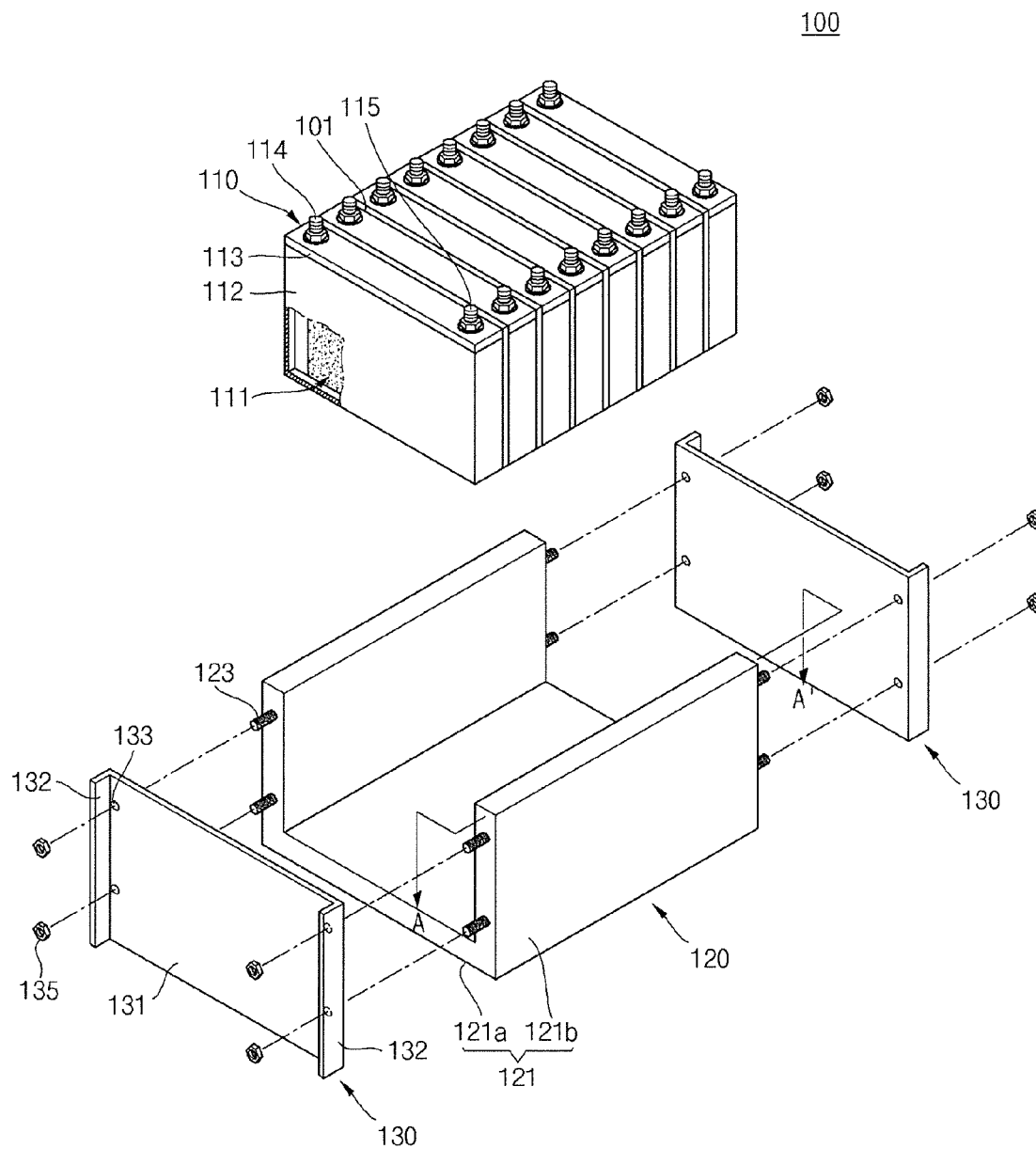


FIG. 3

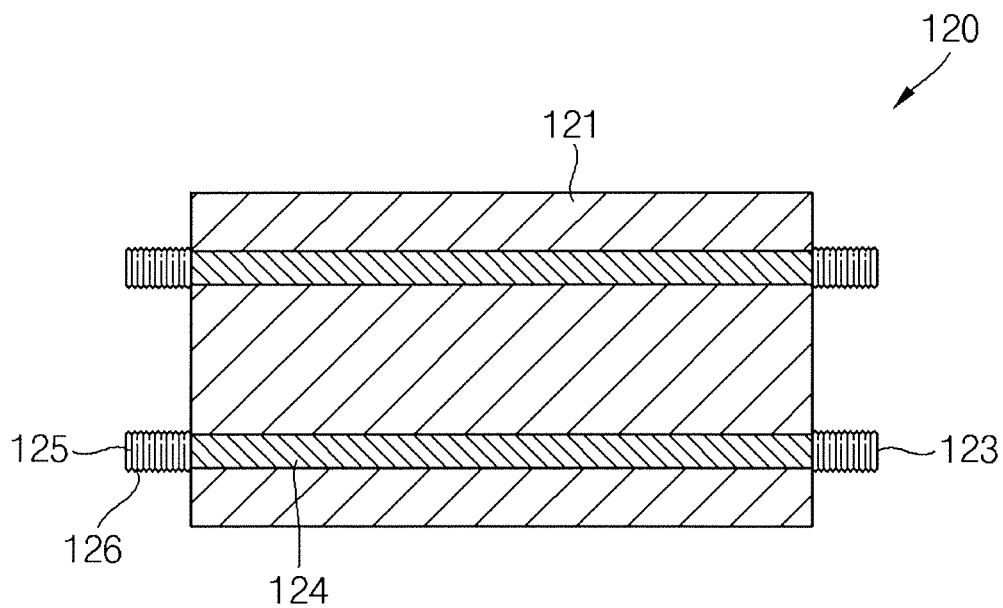


FIG. 4

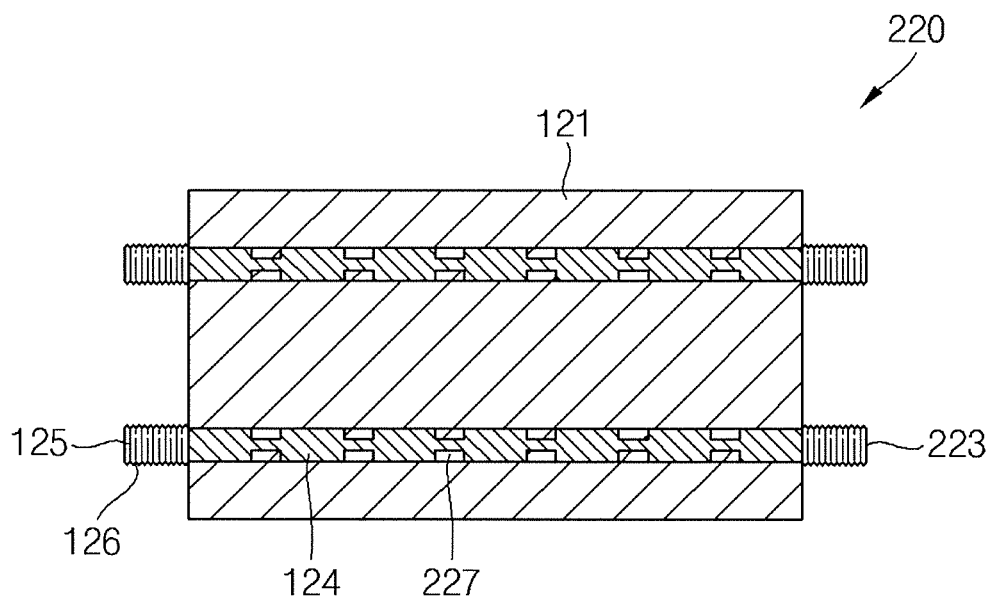


FIG. 5

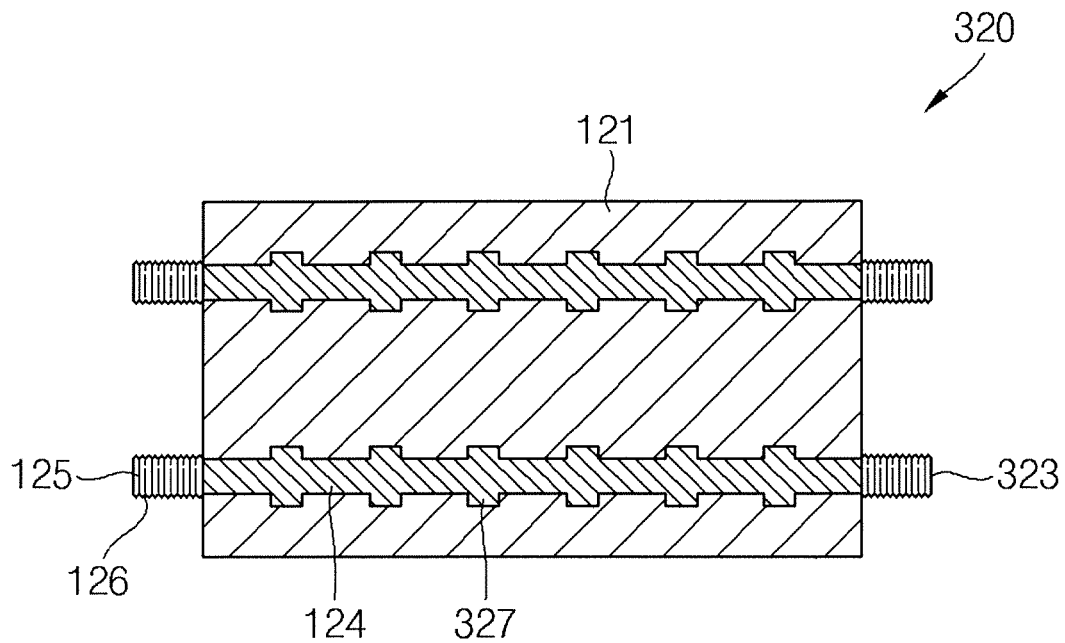


FIG. 6

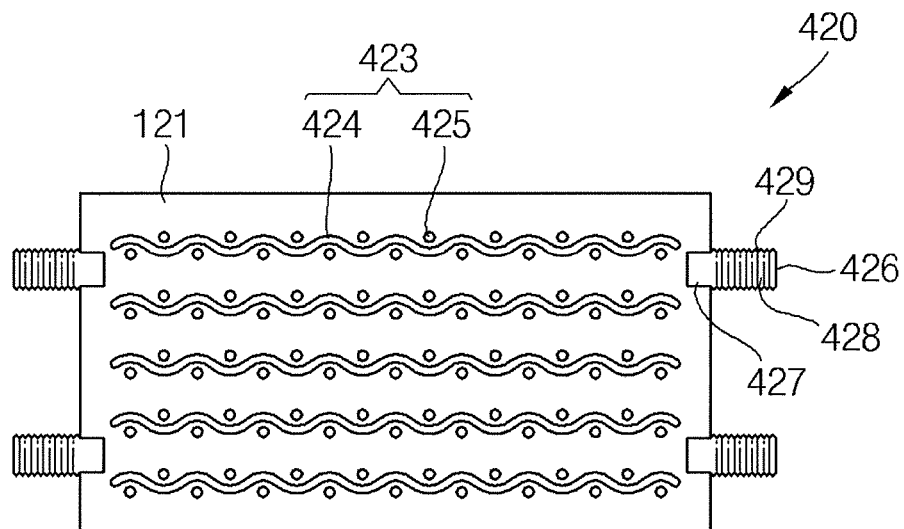


FIG. 7

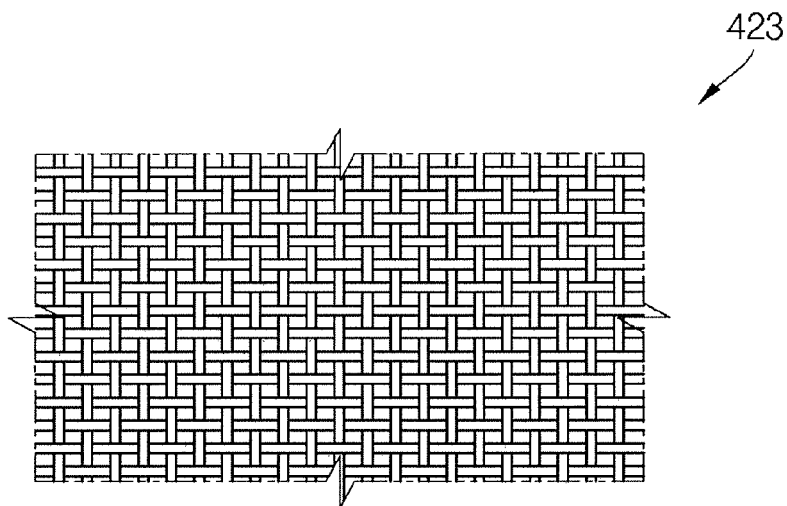
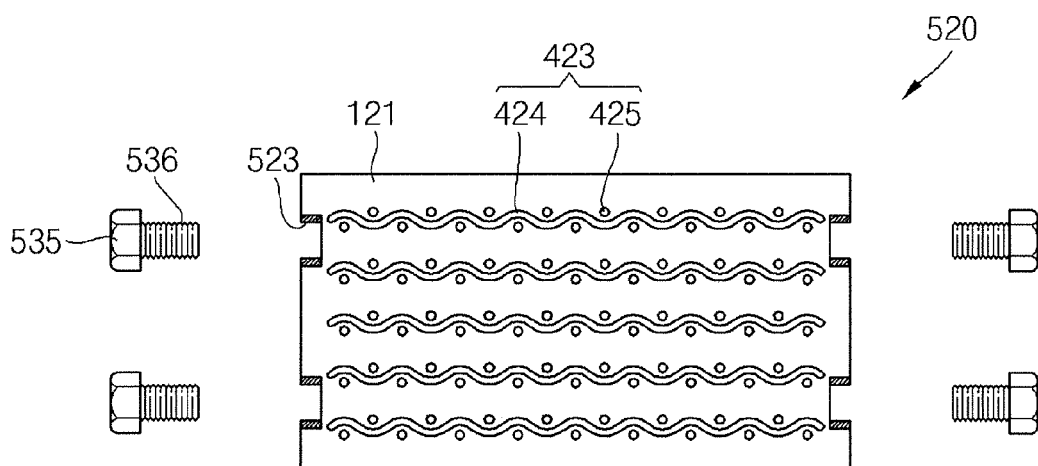


FIG. 8



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**BATTERY PACK****CROSS-REFERENCE TO RELATED APPLICATION**

This application claims priority to and the benefit of Korean Patent Application No. 10-2010-0051137, filed on May 31, 2010, the entire content of which is incorporated herein by reference.

**BACKGROUND**

## 1. Field

The present invention relates to a battery pack.

## 2. Description of the Related Art

In general, secondary batteries are capable of being charged and discharged and can be repeatedly used. Low-capacity secondary batteries, each including a single unit cell, are widely used in small portable electronic devices, such as mobile phones, notebook type computers, cameras, camcorders, and the like. On the other hand, large-capacity secondary batteries, each including multiple battery cells, may be used as motor driving power sources, such as a hybrid electric vehicle (HEV), an electric vehicle (EV), an electric scooter, or the like.

A battery pack includes various components including a plurality of battery cells, fixing members, a case, and so on. However, these components may impede attainment of compact and lightweight battery packs.

**SUMMARY**

According to one or more embodiments of the present invention, a battery pack includes a frame integrated with a reinforcement member and a supporting member, thereby providing a compact and lightweight dimension of the battery pack.

One embodiment of the present invention provides a battery pack including a plurality of battery cells stacked together; a frame comprising a supporting member covering the battery cells and a reinforcement member within the supporting member; and an end plate on the battery cells and coupled to the frame.

In one embodiment, the supporting member and the reinforcement member are made from different materials and are insert molded to each other. For example, the supporting member may be made from an insulating resin and the reinforcement member may be made from a metallic material. Further, a portion of the reinforcement member may protrude from the supporting member and extend through the end plate.

In one embodiment, the supporting member includes a bottom portion covering one side of each of the plurality of battery cells; and a sidewall portion bent and extending from at least two sides of the bottom portion and covering two sides of each of the battery cells. The reinforcement member may be located in the sidewall portion and may include a base portion comprising a bar and extending in a direction generally parallel to a direction in which the battery cells are stacked; an extending portion extending from the base portion and protruding from the supporting member and passing through the end plate; and a screw thread on the extending portion.

In one embodiment, the reinforcement member includes a plurality of coupling grooves and wherein the plurality of coupling grooves contain the supporting member. In another embodiment, the reinforcement member includes a plurality

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of coupling protrusions protruding from an outer surface of the reinforcement member. Further, the end plate may include a plate portion facing the plurality of battery cells and having an opening, wherein the reinforcement member extends through the opening; and a bent portion bent from and extending from two sides of the plate portion.

As described above, the battery pack according to the embodiments of the present invention includes a frame having a reinforcement member and a supporting member coupled to each other by, for example, insert molding, thereby simplifying the manufacturing process and minimizing a size of the battery pack.

In addition, the battery pack according to the embodiments of the present invention includes a reinforcement member and a supporting member made of different materials, thereby dispersing stress applied due to an external force.

Further, the battery pack according to the embodiments of the present invention includes a reinforcement member made of a metallic material and a supporting member made of an insulating resin, thereby increasing mechanical strength, maintaining the shape and minimizing size while improving a heat dissipation capability and an insulating capability.

Additional aspects of the invention will be set forth in part in the description that follows.

**BRIEF DESCRIPTION OF THE DRAWINGS**

The objects, features and advantages of the present invention will be more apparent from the following detailed description in conjunction with the accompanying drawings, in which:

FIG. 1 is a perspective view of a battery pack according to an embodiment of the present invention;

FIG. 2 is an exploded perspective view of the battery pack shown in FIG. 1;

FIG. 3 is a cross-sectional view taken along the line A-A' of FIG. 2;

FIG. 4 is a cross-sectional view illustrating a part of a battery pack corresponding to FIG. 3, according to another embodiment of the present invention;

FIG. 5 is a cross-sectional view illustrating a part of a battery pack corresponding to FIG. 3, according to still another embodiment of the present invention;

FIG. 6 is a cross-sectional view illustrating a part of a battery pack corresponding to FIG. 3, according to still another embodiment of the present invention;

FIG. 7 is a plan view illustrating a reinforcement member shown in FIG. 6; and

FIG. 8 is a cross-sectional view illustrating a part of a battery pack corresponding to FIG. 3, according to still another embodiment of the present invention.

**DETAILED DESCRIPTION**

Hereinafter, embodiments of the present invention will be described in detail with reference to the accompanying drawings.

FIG. 1 is a perspective view of a battery pack according to an embodiment of the present invention, FIG. 2 is an exploded perspective view of the battery pack shown in FIG. 1, and FIG. 3 is a cross-sectional view taken along the line A-A' of FIG. 2.

Referring to FIGS. 1 and 2, the battery pack 100 according to an embodiment of the present invention includes a plurality of battery cells 110, a frame 120 and an end plate 130.

The plurality of battery cells 110 may be stacked together, and are connected to each other in series or parallel by an



electrical connection member. The plurality of battery cells **110** are configured to be connected or coupled to external electronic devices and to perform discharge operations for supplying power to the external electronic devices or charge operations for receiving power from the external electronic devices.

Each of the plurality of battery cells **110** includes an electrode assembly **111** having a positive electrode plate and a negative electrode plate with a separator located therebetween, a case **112** providing for a space in which the electrode assembly **111** is housed, a cap assembly **113** coupled to the case **112** to hermetically sealing the case **112**, and a positive electrode terminal **114** and a negative electrode terminal **115** electrically connected to the positive electrode plate and the negative electrode plate, respectively, and protruding from the cap assembly **113**. Here, an insulator **101** having a relatively small thickness may be located between two adjacent battery cells **110** to prevent an unnecessary short-circuit. In addition, a thin insulator **101** may be attached to an outer surface of the outermost batter cell of the plurality of battery cells **110**. In the following description of the current embodiment, a direction in which the positive electrode terminal **114** and the negative electrode terminal **115** are exposed from the battery cell **110** is referred to as an upper direction.

The frame **120** is formed to cover the plurality of battery cells **110**, and to fix the plurality of battery cells **110** and protect the same from external impact. The frame **120** includes a supporting member **121** and a reinforcement member **123** coupled to each other by, for example, insert molding. Here, the insert molding is a technique of combining components made of two different materials into one body.

The supporting member **121** forms the external appearance of the frame **120**. Specifically, the supporting member **121** includes a bottom portion **121a** covering the bottom portion of the plurality of battery cells **110**, and a sidewall portion **121b** bent and extending from both sides of the bottom portion **121a** to cover both sides of the plurality of battery cells **110**. The supporting member **121** serves to support the shape of the frame **120**. To this end, the supporting member **121** may be made of an insulating resin that is substantially indeformable.

The reinforcement member **123** is formed within the supporting member **121** and serves to reinforce the strength of the frame **120**. To this end, the reinforcement member **123** may be made of a metal having high strength, for example, stainless steel. Here, the reinforcement member **123** may be at least one restraint rod positioned at the sidewall portion **121b** of the supporting member **121**. A portion of the reinforcement member **123** is exposed from the supporting member **121** to then pass through the end plate **130**.

In detail, as shown in FIG. 3, the reinforcement member **123** includes a base portion **124**, an extending portion **125**, and a screw thread **126**. FIG. 3 shows a portion of the sidewall portion **121b** of the supporting member **121**, in which the reinforcement member **123** is positioned. The base portion **124** is a bar extends in a direction substantially parallel to a direction in which the plurality of battery cells **110** are stacked. The extending portion **125** extends from the base portion **124** so as to be exposed from the supporting member **121** and passes through the end plate **130**. The screw thread **126** is formed on the outer surface of the extending portion **125** and allows the nut **135** to be fastened with the extending portion **125**.

As described above, the frame **120** is formed such that the supporting member **121** and the reinforcement member **123** are coupled to each other by, for example, insert molding, thereby simplifying the manufacturing process of the battery

pack **100** and achieving a compact dimension of the battery pack **100**. In addition, since the supporting member **121** and the reinforcement member **123** of the frame **120** are formed using different materials, the stress applied to the battery pack **100** can be dispersed. Further, since the reinforcement member **123** is made of a metallic material and the supporting member **121** is made of an insulating resin, the frame **120** may improve the heat dissipation capability and the insulating capability of the battery pack **100**. Further, compared to a frame made of only a resin, the frame **120** of the embodiments of the present invention may have increased mechanical strength and is capable of maintaining the shape of the battery pack **100** while minimizing a weight of the battery pack **100**, unlike a frame made of only a metal.

With reference again to FIG. 2, the end plate **130** is formed to cover exterior sides of the plurality of battery cells **110**, specifically, both sides that are not covered by the frame **120**, and is coupled to the frame **120** to then be fixed. The end plate **130** fixes the plurality of battery cells **110** together with the frame **120**. The end plate **130** may be made of a metal or a resin, and may include a plate portion **131**, a bent portion **132**, and a throughhole or opening **133**.

The plate portion **131** faces and covers the battery cell **110** and is coupled to the frame **120**.

The bent portion **132** is bent and extends from both edges of the plate portion **131**. The bent portion **132** reinforces the mechanical strength of the end plate **130**, thereby preventing the end plate **130** from being significantly bent due to an external force.

The throughhole **133** is formed at a region of the plate portion **131** generally corresponding to the extending portion **125** of the reinforcement member **123**, and the extending portion **125** of the reinforcement member **123** is inserted into the throughhole **133**.

The end plate **130** is fixedly coupled to the frame **120** such that the extending portion **125** of the reinforcement member **123** is inserted into the throughhole **133** of the end plate **130** and the nut **135** is fastened with the extending portion **125** through the screw thread **126** of the reinforcement member **123**.

As described above, the battery pack **100** according to the embodiment of the present invention includes the frame **120** having the supporting member **121** and the reinforcement member **123** coupled to each other by, for example, insert molding, thereby simplifying the manufacturing process thereof while minimizing a size of the battery pack.

In addition, in the battery pack **100** according to the embodiment of the present invention, since the supporting member **121** and the reinforcement member **123** are formed using different materials, the stress applied due to an external force can be dispersed.

Further, in the battery pack **100** according to the embodiment of the present invention, because the supporting member **121** is made of an insulating resin and the reinforcement member **123** is made of a metallic material, the heat dissipation capability and the insulating capability of the battery pack **100** can be improved, and shape maintaining capability and minimized weight of the battery pack **100** can also be achieved while increasing mechanical strength of the battery pack **100**.

A battery pack corresponding to FIG. 4, according to another embodiment of the present invention will now be described.

FIG. 4 is a cross-sectional view illustrating a part of a battery pack generally corresponding to FIG. 3, according to another embodiment of the present invention.

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The battery pack according to this embodiment is substantially the same as the battery pack 100 according to the previous embodiment in view of configuration and function, except for the shape of a reinforcement member 223 of a frame 220, and therefore a description of the similar components will be omitted. In the following, the battery pack according to this embodiment will be described with regard to the reinforcement member 223 of the frame 220.

Referring to FIG. 4, the frame 220 is formed by coupling a supporting member 121 and the reinforcement member 223 to each other by, for example, insert molding.

The reinforcement member 223 is substantially the same as the reinforcement member 123 shown in FIG. 3, except that it further includes a plurality of coupling grooves 227 formed on the outer surface of a base portion 124. The plurality of coupling grooves 227 allow the supporting member 121 to be filled to be securely fixed.

As described above, the battery pack according to the embodiment further includes the plurality of coupling grooves 227 formed in the reinforcement member 223, thereby increasing coupling strength between the reinforcement member 223 and the supporting member 121 made of different materials.

A battery pack according to still another embodiment of the present invention will now be described.

FIG. 5 is a cross-sectional view illustrating a part of a battery pack according to still another embodiment of the present invention, the part corresponding to FIG. 3.

The battery pack according to this embodiment is substantially the same with the battery pack 100 according to the previous embodiment in view of configuration and function, except for the shape of a reinforcement member 323 of a frame 320, and a description of the similar components will be omitted. In the following, the battery pack according to this embodiment will be described with regard to the reinforcement member 323 of the frame 320.

Referring to FIG. 5, the frame 320 is formed by coupling a supporting member 121 and the reinforcement member 323 to each other by, for example, insert molding.

The reinforcement member 323 is substantially the same as the reinforcement member 123 shown in FIG. 3, except that it further includes a plurality of coupling protrusions 327 formed on the outer surface of a base portion 124. The plurality of coupling protrusions 327 serve as supporters resisting against external forces while increasing coupling strength between the reinforcement member 323 and the supporting member 121 made of different materials.

As described above, the battery pack according to the embodiment further includes the plurality of coupling protrusions 327 formed in the reinforcement member 323, thereby further increasing coupling strength between the reinforcement member 323 and the supporting member 121 made of different materials and increasing resistance against external forces.

Next, a battery pack according to still another embodiment of the present invention will be described.

FIG. 6 is a cross-sectional view illustrating a part of a battery pack according to still another embodiment of the present invention, the part corresponding to FIG. 3, and FIG. 7 is a plan view illustrating a reinforcement member shown in FIG. 6.

The battery pack according to this embodiment is substantially the same with the battery pack 100 according to the previous embodiment in view of configuration and function, except for the shape of a reinforcement member 423 of a frame 420, and a description of the similar components will be omitted. In the following, the battery pack according to this

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embodiment will be described with regard to the reinforcement member 423 of the frame 420, and a connection member 426.

Referring to FIGS. 6 and 7, the frame 420 is formed by coupling a supporting member 121, the reinforcement member 423 and the connection member 426 by, for example, insert molding.

The reinforcement member 423 is formed within the supporting member 121 and reinforces mechanical strength of the frame 420. To this end, the reinforcement member 423 may be made of a metal having high strength, for example, stainless steel. Here, the reinforcement member 423 may be formed in a mesh type. Specifically, the reinforcement member 423 includes a first metal line 424 and a second metal line 425. The reinforcement member 423 is formed throughout a sidewall portion of the supporting member 121, thereby further increasing mechanical strength of the frame 420.

The connection member 426 may be formed at a region corresponding to the throughhole 133 of the end plate (130 of FIG. 2) in the frame 420, and may be a bolt. The connection member 426 includes a base portion 427 formed outside the reinforcement member 423 within the supporting member 121, an extending portion 428 exposed to one side of the supporting member 121, and a screw thread 429 formed on the outer surface of the extending portion 428. The extending portion 428 of the connection member 426 is inserted into the throughhole 133 of the end plate 130 and a nut (135 of FIG. 2) is fastened with the extending portion 428 through the screw thread 429, thereby allowing the end plate 130 to be fixedly coupled to the frame 420.

As described above, the battery pack according to the embodiment includes the mesh-type reinforcement member 423 throughout the sidewall portion of the supporting member 121, thereby further increasing the mechanical strength of the frame 420 and ultimately further increasing resistance against external forces.

A battery pack according to still another embodiment of the present invention will now be described.

FIG. 8 is a cross-sectional view illustrating a part of a battery pack according to still another embodiment of the present invention, the part generally corresponding to FIG. 3.

The battery pack according to this embodiment is substantially the same as the battery pack 100 according to the previous embodiment in view of configuration and function, except that the shape of a reinforcement member 423 of a frame 520, and a connection member 523 and a bolt 535 are further provided. As such, a description of the similar components will be omitted. In the following, the battery pack according to this embodiment will be described with regard to the reinforcement member 423 of the frame 520, the connection member 523 and the bolt 535.

Referring to FIG. 8, the frame 520 is formed by coupling a supporting member 121, the reinforcement member 423 and the connection member 523 to each other by, for example, insert molding.

Since the reinforcement member 423 is substantially the same as previously described with reference to FIG. 6, it will not be described again.

The connection member 523 may be formed at a region corresponding to the throughhole 133 of the end plate (130 of FIG. 2) in the frame 520, and may be a nut. The connection member 523 is formed outside the reinforcement member 423 within the supporting member 121 so as to be exposed from one side of the supporting member 121.

The bolt 535 includes a screw thread 536 formed on a portion of its outer surface, and passes through the throughhole 133 of the end plate (130 of FIG. 2) to then be fastened

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with the connection member **523**, thereby allowing the frame **520** to be fixedly coupled to the end plate (**130** of FIG. **2**). Since the bolt **535** is used in coupling the frame **520** and the end plate (**130** of FIG. **2**), the nut **135** of FIG. **2** may be omitted.

As described above, the battery pack according to the embodiment includes the mesh-type reinforcement member **423** throughout the sidewall portion of the supporting member **121**, thereby further increasing the mechanical strength of the frame **520** and ultimately further increasing resistance against external forces.

Although the battery pack according to the present invention has been illustrated through particular embodiments, it should be understood that many variations and modifications may be made in those embodiments within the scope of the present invention.

What is claimed is:

1. A battery pack comprising:
  - a plurality of battery cells stacked together;
  - a frame comprising a supporting member covering the battery cells and a reinforcement member within and directly contacting the supporting member, wherein the frame extends continuously along a length of all of the battery cells; and
  - an end plate on the battery cells and coupled to the frame, wherein the supporting member comprises:
    - a bottom portion covering one side of each of the plurality of battery cells; and
    - a sidewall portion bent and extending from at least two sides of the bottom portion and covering two sides of each of the battery cells, wherein a part of the reinforcement member is entirely within the sidewall portion and extends along an entire length of the supporting member.
2. The battery pack of claim **1**, wherein the supporting member and the reinforcement member comprise different materials.
3. The battery pack of claim **1**, wherein the supporting member and the reinforcement member are insert molded to each other.
4. The battery pack of claim **1**, wherein the supporting member comprises an insulating resin.
5. The battery pack of claim **1**, wherein the reinforcement member comprises a metallic material.
6. The battery pack of claim **1**, wherein a portion of the reinforcement member protrudes from the supporting member and extends through the end plate.

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7. The battery pack of claim **6**, further comprising a nut on an exterior side of the end plate and coupled to the reinforcement member.

8. The battery pack of claim **1**, wherein the reinforcement member is located in the sidewall portion.

9. The battery pack of claim **1**, wherein the reinforcement member comprises:

- a base portion comprising a bar and extending in a direction generally parallel to a direction in which the battery cells are stacked;

- an extending portion extending from the base portion and protruding from the supporting member and passing through the end plate; and

- a screw thread on the extending portion.

10. The battery pack of claim **1**, wherein the reinforcement member includes a plurality of coupling grooves and wherein the plurality of coupling grooves contain the supporting member.

11. The battery pack of claim **1**, wherein the reinforcement member includes a plurality of coupling protrusions protruding from an outer surface of the reinforcement member.

12. The battery pack of claim **1**, wherein the end plate comprises:

- a plate portion facing the plurality of battery cells and an opening, wherein the reinforcement member extends through the opening; and

- a bent portion bent from and extending from two sides of the plate portion.

13. The battery pack of claim **1**, further comprising a connection member on the reinforcement member, wherein the connection member is coupled to the end plate.

14. The battery pack of claim **13**, wherein the connection member is a bolt passing through the end plate, and wherein the battery pack further comprises a nut coupled to the connection member.

15. The battery pack of claim **13**, wherein the connection member is a nut, and wherein the battery pack further comprises a bolt extending through the end plate and coupled to connection member.

16. The battery pack of claim **13**, wherein the reinforcement member is a mesh type.

17. The battery pack of claim **16**, wherein the reinforcement member comprises a first metal line and a second metal line.

18. The battery pack of claim **1**, further comprising an insulator located between two adjacent battery cells among the plurality of battery cells.

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